

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number  
**WO 2004/001192 A1**

(51) International Patent Classification<sup>7</sup>: **E21D 20/02**,  
21/00

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(21) International Application Number:  
PCT/AU2003/000760

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC,  
SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG,  
US, UZ, VC, VN, YU, ZA, ZM, ZW.

(22) International Filing Date: 20 June 2003 (20.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
PS 3107 21 June 2002 (21.06.2002) AU

(84) Designated States (*regional*): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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Published:

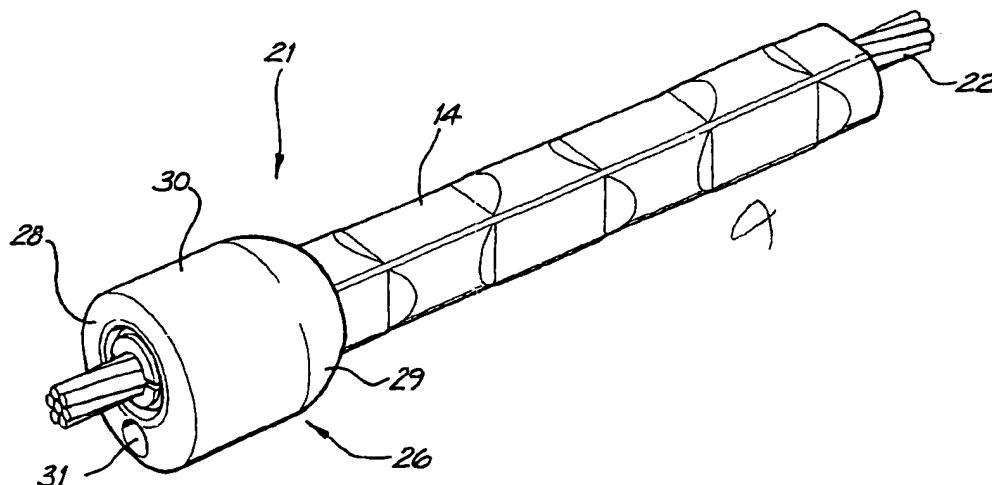
— with international search report

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For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: ROCK BOLTING SYSTEM



(57) Abstract: The present invention discloses a tube (14) for rock bolts having either a cable tendon or a rod tendon. The tube is deformed to permit the tube to be coiled and yet also provide good keying between the tube and grout. In addition, a fitting (26, 46) for the rear end of the bolt is disclosed in which a grouting orifice (31) communicates with a cable passageway (34). Furthermore, the use of two or more cable anchors (57) at the far end of the bolt is disclosed where the bolt is intended to be used in poor ground conditions, such as sandstone.

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## ROCK BOLTING SYSTEM

### Field of the Invention

The present invention relates to rock bolts, whether the bolt tendon is formed from a flexible cable or a rigid rod, the grout delivery tube for such bolts, and the fabrication  
5 of such tubes.

### Background Art

Rock bolts are widely used in civil engineering and mining applications to stabilise rock strata.

10

Essentially a blind hole or bore is drilled in the rock and a rock bolt having an anchor at its far end is inserted into the hole. The anchor is operated so as to grip the far end of the hole and secure the bolt in the hole. The bolt is surrounded by a tube and grout is pumped into the gap between the bolt and the tube. The grout passes down the tube  
15 until it reaches the anchor and then begins to flow back out of the hole between the interior of the hole and the exterior of the tube. The operator ceases to pump grout when the returning grout is observed escaping from the hole. The grout hardens and provides a force transmitting structure between the interior of the hole and the length of the rock bolt. In this way the steel bolt can react effectively against any movement  
20 in the surrounding ground.

### Object of the Invention

The object of the present invention is to provide an improved tube, a cable bolt incorporating the tube, bolt fittings and fabrication techniques all of which together  
25 constitute an improved rock bolting system.

### Summary of the Invention

In accordance with the first aspect of the present invention there is disclosed a tube for cable or rod bolt applications, said tube being extruded from plastics material and  
30 deformed beyond its yield point at a plurality of longitudinally spaced apart locations, along the length of the tube, each said deformation occurring in at least two different directions.

In accordance with the second aspect of the present invention there is disclosed a rock bolt having a tendon located within the above defined tube.

5 In accordance with a still further aspect of the present invention there is disclosed an end fitting for a rock bolt, said fitting comprising a barrel having a substantially flat front end, a rear end, a curved side wall, and a longitudinal axis, a cable passageway passing between said front and rear ends, and a grouting orifice extending from said front end into said cable passageway.

10 In accordance with a fourth aspect of the present invention there is disclosed a method of fabricating a tube for a rock bolt, said method comprising the step of radially deforming the side wall of said tube beyond its yield point in at least two different directions, at each of a plurality of longitudinally spaced locations.

15 In accordance with another aspect of the present invention there is disclosed a rock bolt for use in poor ground conditions, said bolt having a near end and a far end, anchor means at said far end to anchor the far end adjacent the base of a blind hole formed in said ground, and tension means at said near end to tension said bolt after said far end has been anchored, wherein said anchor means comprises at least two  
20 anchor devices, each known per se, and connected in series adjacent said far end.

In accordance with a still further aspect of the present invention there is disclosed a method of securing a rock bolt in poor ground conditions, said method comprising the steps of:

25 providing at least two anchor devices, each known per se, at the far end of said rock bolt,  
inserting said rock bolt into a blind hole drilled in said ground,  
activating all said anchor devices, and  
tensioning said rock bolt.

30

Preferably, following tensioning of the rock bolt, the bolt is surrounded with grout.

Brief Description of the Drawings

The prior art and the embodiments of the present invention will now be described with reference to the drawings in which,

5 Fig. 1 is an exploded perspective view of a prior art rock bolt prior to installation,

Fig. 2 is longitudinal partly cross sectional view through the rock bolt of Fig. 1 as installed,

Fig. 3 is a perspective view of the tube of the preferred embodiment,

10 Fig. 4 is an end view of the tube of Fig. 3,

Fig. 5 is a plan view of the tube of Fig. 3,

Fig. 6 is a side elevation of the tube of Fig. 3,

Fig. 7 is perspective view of the near end of a cable bolt incorporating the tube of Fig. 3-6,

15 Fig. 8 is a plan view of the cable bolt end of Fig. 7,

Fig. 9 is an end elevation of the arrangement of Figs. 7 and 8,

Fig. 10 is a longitudinal cross sectional view taken along the line X-X of Fig. 9,

Fig. 11 is an end view of the free end of the cable bolt of Fig. 7,

20 Fig. 12 is a perspective view of another embodiment of the end fitting of the cable bolt of Fig. 7,

Fig. 13 is an end view of the fitting of Fig. 12,

Fig. 14 is the opposite end view of the fitting of Fig. 12,

Fig. 15 is an alternative perspective view of the fitting of Fig. 12, and

25 Fig. 16 is a longitudinal partly cross-sectional view of the far end of a rock bolt.

Figs. 1 and 2 illustrate a prior art rock bolt known as the "CT bolt" which is generally as described in Australian Patent No. 669,393 (Application No. 49856/93 and  
30 WO 94/05900). The CT bolt 1 has a solid steel tendon 2 with an anchor 3 (illustrated only in a general cylindrical form in Fig. 1) located at its far end. A tube 4 having a plurality of papillae 13 surrounds the tendon 2 and the near end of the CT bolt 1 has a washer plate 5, a hollow dome ball 6, and nut 7.

As seen in Fig. 2, a blind hole 8 is drilled in the ground 9 and the CT bolt inserted therein. The anchor 3 is expanded so that it grips the interior of the hole 8 thereby locating the CT bolt 1 in its final position. The bolt can be tensioned by means of the  
5 nut 7 engaging a thread on the near end of the bolt. Then a flowable hardenable cementitious grout 10 is pumped into a small grout orifice 11 from where the grout passes between the tendon 2 and the interior of the tube 4. As the grout moves down the hole 8 between the tendon 2 and tube 4, air is being expelled from the hole 8 by passing between the interior of the hole 8 and the exterior of the tube 4. Eventually  
10 the grout 10 reaches the end of the hole 8 and the anchor 3 and then passes between the hole interior and the external surface of the tube 4. Eventually grout is expelled from the hole 8 adjacent the washer plate 5 indicating to the operator to cease pumping grout.

15 The purpose of small papillae 13 formed in the tube 4 is to provide a keying mechanism to enable longitudinal shearing forces to be transferred between the ground 9 and the tendon 2 by means of the grout 10.

Current methods of deforming the tube 4 involve processing the tube when it is hot  
20 and soft immediately after being formed and upon the tube exiting from the plastic extruder which creates the tube 4 from raw granular material. The tube in this soft and hot state enters another machine termed a "corrugator" which has a series of external moulds into which the tube is forced by compressed air from the inside, or vacuum applied from the outside, or both, so that the hot tube takes the shape of the  
25 moulds.

Such corrugators are known to produce corrugated plastic drainage pipe and corrugated swimming pool hose. Corrugated tube is known to be used in relation to rock bolts but suffers from a number of disadvantages. Firstly, the corrugating  
30 process is slow and therefore relatively expensive. Secondly, although the corrugated tubing has the advantage of being flexible and resistant to crushing, the geometry of corrugated tubing creates a number of disadvantages. In particular, the close corrugations, extending in an annular fashion relative to the axis of the tube,

commonly trap air when the grout material is pumped therepast. These pockets of trapped air very substantially reduce the capacity of the tube to transfer mechanical loads. A similar problem is that the small amount of grouting material in the annular corrugations does not have the strength, because of its small mass and volume, to resist the shearing forces experienced in use. Therefore corrugated tube easily shears the grout from one annular deformation to the next.

In addition, the annular deformations of the corrugated tube catch on many types of objects during the installation procedure such as load plates, wire mesh, the parts of the installing machinery, and the like, all of which can lead to damage of the tube. If the corrugated tube is damaged the bolt can be uninstallable and/or unable to be grouted. This is because a hole in the tube will effectively "short circuit" the grouting procedure and result in grout not being delivered to the full length of the hole.

Whilst the known corrugated tube is flexible, and thus is able to be looped into a coil, the tube 4 of Figs. 1-2 is not. This tube, for example fabricated for installation in 45mm bore holes, is substantially round and has a diameter of approximately 35mm. Each papilla 13 is formed as one of three outwardly extending bumps spaced equally around the tube at locations spaced apart by approximately 50mm along the tube. The maximum "diameter" of the tube at the location of the papillae is approximately 42mm. The tube 4 is produced on a corrugator machine but without producing corrugations. The tube is stiff and thus cannot be bent or coiled up as this results in the tube kinking and/or breaking. The papillae 13 on the tube 4 are also susceptible to being sheared off if the tube is handled roughly prior to installation.

The cost of the tube 4 is approximately three times the cost of similar tube (so called polytube made from high density polyethylene (HDPE)) used extensively in irrigation applications. It would therefore be desirable if this inexpensive tubing could be used for rock bolting applications.

Figs. 3-6 illustrate a deformed irrigation polytube 14 which has been deformed in such a way as to still retain its flexibility and thereby permit the polytube 14 to be coiled or looped into a coil. The polytube 14 is deformed by being placed between

forming tools, which yield the material of the tube 14 in small areas. The yielding stops the material of the polytube 14 from returning to its original configuration. With reference to Fig. 3, in one embodiment, the tube 14 is compressed by having inwardly oppositely directed forces F1 and F2 applied to its "sides" whilst  
 5 substantially simultaneously two inwardly oppositely directed forces F3 and F4 are applied to its "top" and "bottom" (spaced from but adjacent to the location of the F1 and F2 forces) so as to create generally rectangular bulges 17 having triangularly shaped slopes 18.

10 Because the yielding zones 50 which create the bulges 17 are arranged in sequential fashion along the length of tube 14, these deformed patterns remain deformed and provide a mechanism to enable load transfer from the bolt to the surrounding ground via the grouting applied to both sides of the tube 14. In particular, the shape of the bulges 17 provide a number of advantages in that they reduce the occurrence of  
 15 damage prior to, or during, installation. Similarly, the shape of the bulges 17 reduces the risk of air voids developing during the grouting operation.

Because the tube 14 thus deformed is able to be rolled into a coil, long lengths of rock bolt utilising steel cable as the rock bolt tendon, rather than solid steel rod, are able to  
 20 be formed and also coiled prior to installation. This provides substantial advantages as regards packaging and handling of the bolts prior to installation. It also allows installation of long post grouted bolts in limited access areas.

Figs. 7-11 illustrate the near end of such a cable bolt, the far end being substantially  
 25 conventional. As seen in Figs. 7-11, a cable bolt 21 has a cable 22 which passes through the polytube 14 and is provided with a barrel like end fitting 26 at the near end. The barrel 26 has a flat end face 28 and a domed front face 29 with a substantially cylindrical side wall 30. A grouting orifice 31 is formed in the end face 28 and, as seen in Fig. 10, leads into a grouting passage 32 which is inclined to the  
 30 longitudinal axis of the polypipe 14 and cable 22.

In addition, the barrel 26 has a main passage 34 which includes a frusto-conical wedge 35 which acts a gripping mechanism for the cable 22. Thus the grouting

passage 32 delivers grout above the cable gripping wedges 35 which hold the barrel 26 to the cable 22.

That is, after the hole in the ground has been drilled, the far end of the cable bolt 21  
 5 (not illustrated) is inserted into the hole and an anchor at the far end is activated so as to fix the far end of the bolt in the hole. Then the cable 22 can be placed under tension and the barrel 26 moved towards the far end until the barrel 26 comes into contact with a washer plate, or the like (not illustrated).

10 With the cable 22 thus tensioned, grout is able to be pumped through the grouting orifice 31 and grouting passage 32 into the interior of the polytube 14. The grout then travels along the length of the cable bolt 21, passes out the end of the polytube 14 and returns back towards the barrel 26 this time passing between the interior of the hole and the exterior of the polypipe 14.

15 It will be appreciated that the main passage 34 is not concentric with the cylindrical side wall 30 and thus at the near end of the cable bolt 1 the cable 22 is not concentric with the longitudinal axis of the tube 14.

20 Figs. 12-15 illustrate a second embodiment of a barrel 46 in which the front face 39 is flat. The end face 28 and grouting orifice 31 are substantially as before.

The foregoing describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without  
 25 departing from the scope of the present invention. For example, the bulges 17 in Figs. 3-10 extend in two directions which are substantially perpendicular to each other. It is also possible to arrange to have the bulges extend in three directions which are approximately 120° apart but that the longitudinally adjacent set of bulges should be rotated by 60° relative to the tube axis so that those bulges extend intermediate the  
 30 bulges of the adjacent deformation. This is thought to assist shear load transfer.

In addition, the end fitting or barrel 26, 46 (in addition to being relatively inexpensive to manufacture) can also be used in a cable or rod bolt without the outer plastic tube 4,



14. In this arrangement a breather tube passes through the grouting orifice 31 and grouting passage 32 and then extends alongside the bolt to its far end. Under this arrangement grout is introduced between the bolt and hole and moves towards the far end of the hole but the air displaced by the grout is pushed out through the breather tube. Eventually the grout reaches the far end of the hole and then begins to fill the breather tube. The grouting process is stopped when the grout is seen returning through the breather tube.

Turning now to Fig. 16, the far end of a rock bolt 51 intended for use in poor ground, such as sandstone, is illustrated. In this particular embodiment the cable tendon 52 is formed from multistrand steel cable 22, but a solid tendon could equally be used.

Mounted on the cable 22 are a pair of spaced apart conventional shell anchors 53 such as those disclosed in Australian Patent Application No. 22992/02 which each include a restraining device in the form of a rupturable band 57. The anchors 53 are able to be expanded in known fashion by being spring loaded. In this way the two pivoted halves of the anchors 53 pivot outwardly to grip the interior of the surrounding blind hole 8.

The installation procedure is as follows. The rock bolt 51 is inserted fully into the blind hole 8. The spring expansion shells grip the sandstone surrounding the blind hole 8 with sufficient combined force to enable the cable 22 to be tensioned. Then the entire hole 8 is grouted in a single operation. The entire operation takes only a few minutes.

25

This is to be contrasted with the previous procedure where, following insertion of a rock bolt in poor ground, a sophisticated grout delivery system was used to grout only the far end of the rock bolt. Only after this grout had cured was the rock bolt tensioned. Then the remainder of the bolt was grouted. This prior art process took several weeks.

The foregoing describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

- 5 The term “comprising” (and its grammatical variations) is used in the sense of “having” or “including” and not in the sense of “consisting only of”.

CLAIMS

1. A tube for rock bolts having either a cable tendon or a rod tendon, said tube being extruded from plastics material and deformed beyond its yield point at each of a plurality of longitudinally spaced apart locations extending along the length of the tube, said deformation at each said location occurring in at least two different directions.
2. The tube as claimed in claim 1 and deformed by inwardly directed compression.
3. The tube as claimed in claim 2 wherein at each said location said inwardly directed compression extends in two different directions making an angle with each other.
4. The tube as claimed in claim 3 wherein said angle is substantially 90°.
5. The tube as claimed in claim 2 wherein at each said location said inwardly directed compression extends in three different directions.
6. The tube as claimed in claim 5 wherein the angle between said three directions is approximately 120°.
7. The tube as claimed in any one of claims 1-6 and able to be looped into a coil.
8. The tube as claimed in any one of claims 1-7 and fabricated from irrigation water supply tube.
9. The tube as claimed in any one of claims 1-8 and fabricated from high density polyethylene (HDPE).
10. A rock bolt having a tendon located within a tube as claimed in any one of claims 1-9.
11. The cable bolt as claimed in claim 10 wherein said tendon is formed from multi-strand steel cable and said bolt is looped into a coil.
12. An end fitting for a rock bolt, said fitting comprising a generally barrel-like shape having a front end, a rear end, a curved side wall and a longitudinal axis, and said fitting further having a tendon passageway extending between said front and rear ends, and a grouting orifice in said front end and leading into said cable passageway.
13. The fitting as claimed in claim 12 wherein said tendon passageway includes a cable anchor.
14. The fitting as claimed in claim 13 wherein said cable anchor includes a frusto-conical wedge.

15. The fitting as claimed in any one of claims 12-14 wherein said front end is substantially domed.
16. The fitting as claimed in any one of claims 12-14 wherein said front end is substantially flat.
- 5 17. The fitting as claimed in any one of claims 12-16 wherein said rear end is substantially flat.
18. The fitting as claimed in claim 17 wherein said substantially flat rear end is substantially perpendicular to said longitudinal axis.
19. A method of fabricating a tube for a rock bolt, said method comprising the  
10 step of radially deforming the side wall of said tube beyond its yield point at each of a plurality of longitudinally spaced apart locations extending along the length of the tube, said deformation at each said location occurring in at least two different directions.
20. The method as claimed in claim 19 including the step of creating said  
15 deformation by inwardly directed compression.
21. The method as claimed in claim 20 including the step of: at each said location inwardly directing said compression in two different directions making an angle with each other.
22. The method as claimed in claim 21 wherein said angle is substantially 90°.
- 20 23. The method as claimed in claim 20 including the step of: at each said location inwardly directing said compression in three different directions.
24. The method as claimed in claim 23 wherein the angle between said three directions is approximately 120°.
25. A rock bolt for use in poor ground conditions, said bolt having a near end and  
25 a far end, anchor means at said far end to anchor the far end adjacent the base of a blind hole formed in said ground, and tension means at said near end to tension said bolt after said far end has been anchored, wherein said anchor means comprises at least two anchor devices, each known per se, and connected in series on said bolt adjacent said far end.
- 30 26. The rock bolt as claimed in claim 25 wherein said anchor devices comprise shell anchors.
27. A method of securing a rock bolt in poor ground conditions, said method comprising the steps of:

providing at least two anchor devices, each known per se, at the far end of said rock bolt,

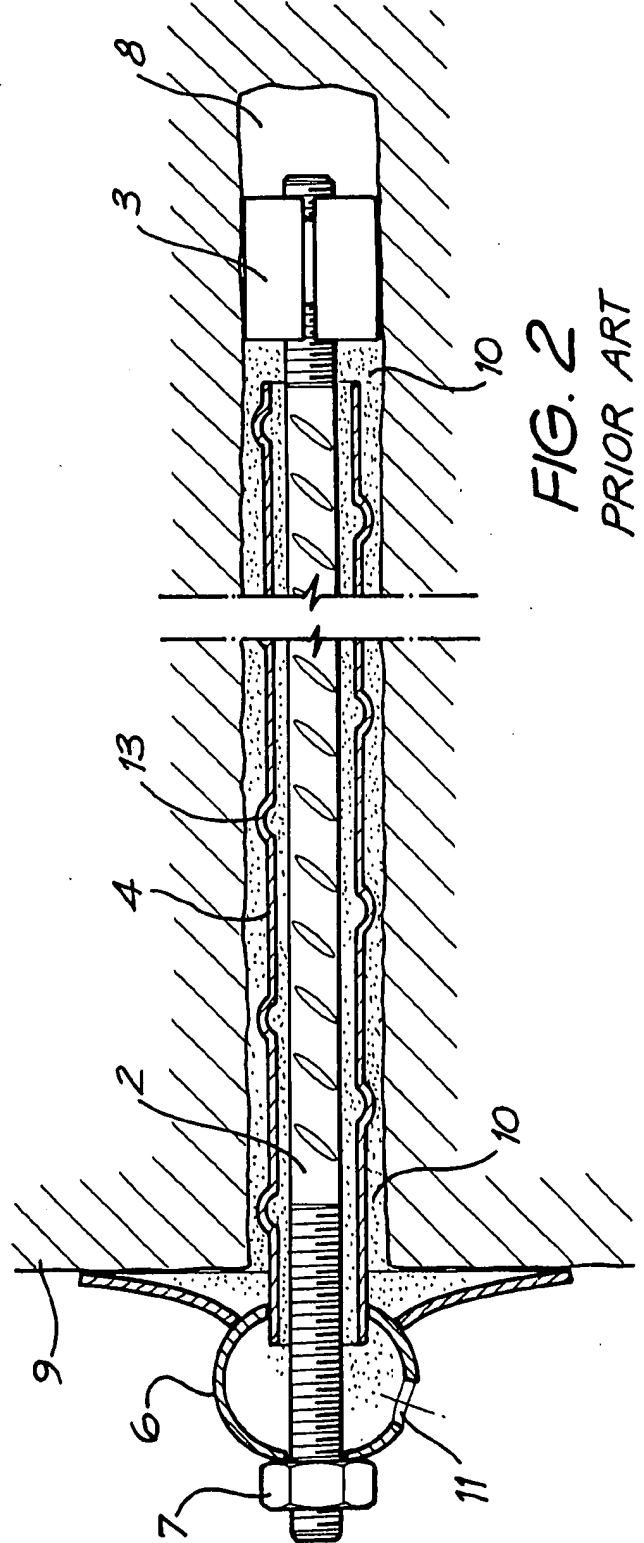
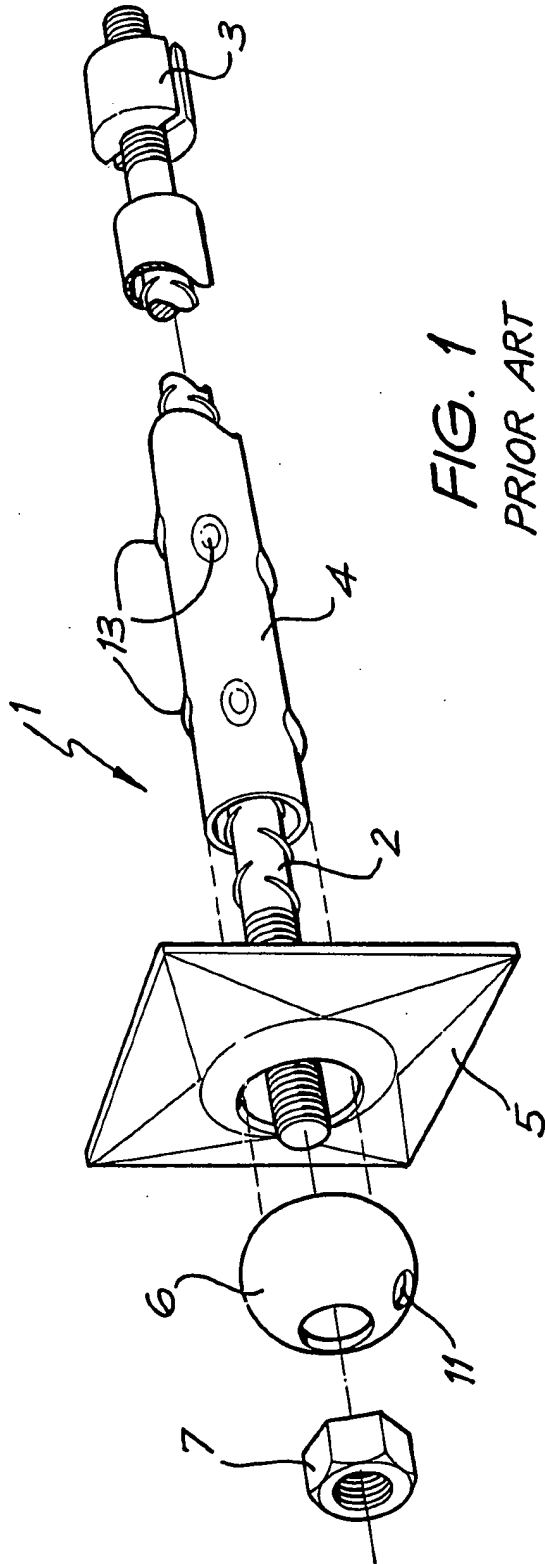
inserting said rock bolt into a blind hole drilled in said ground,

activating all said anchor devices, and

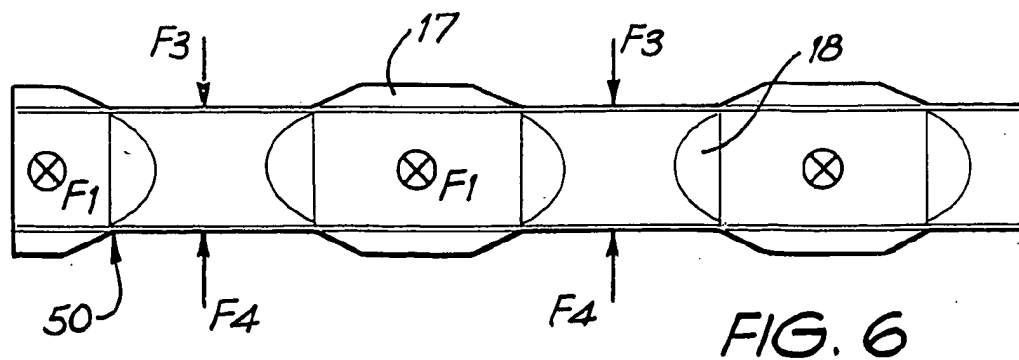
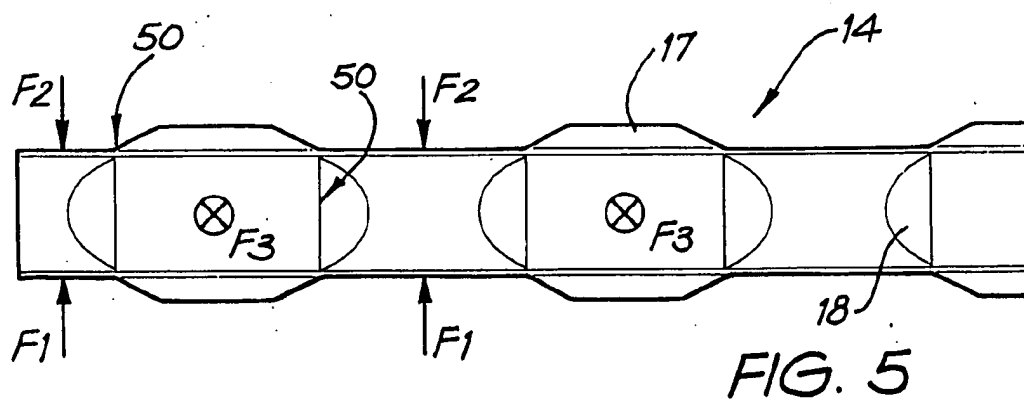
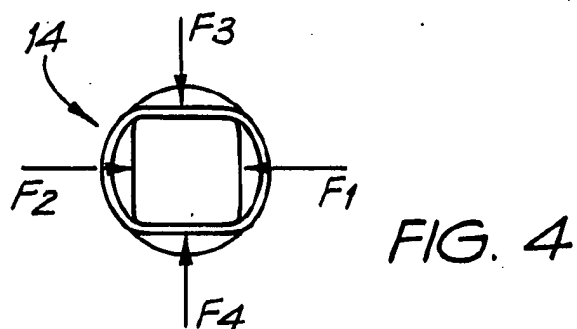
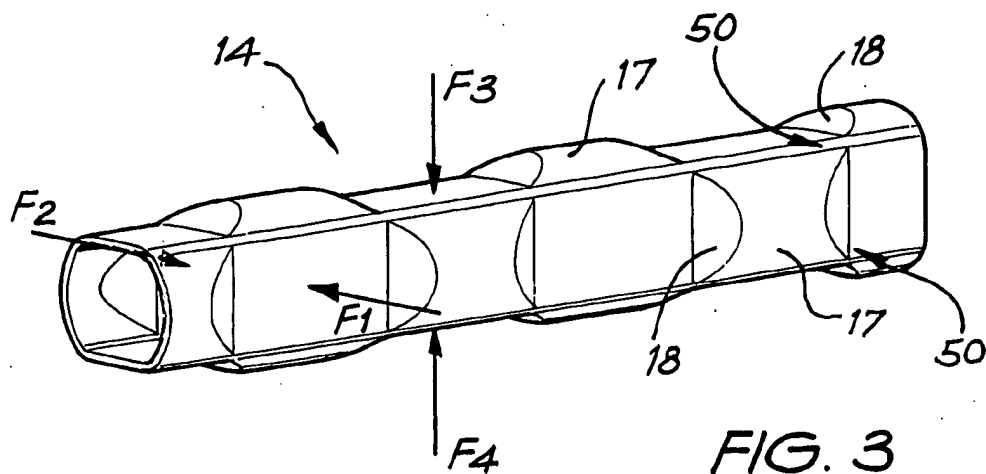
5      tensioning said rock bolt.

28.    The method as claimed in claim 27 wherein following tensioning of said rock bolt, said rock bolt is surrounded with grout.

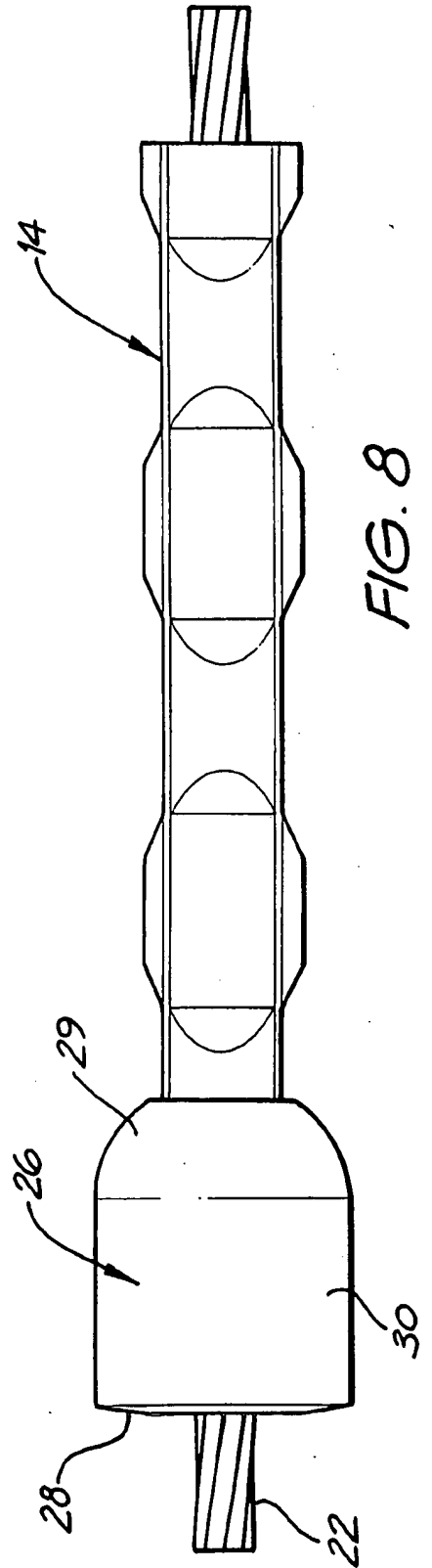
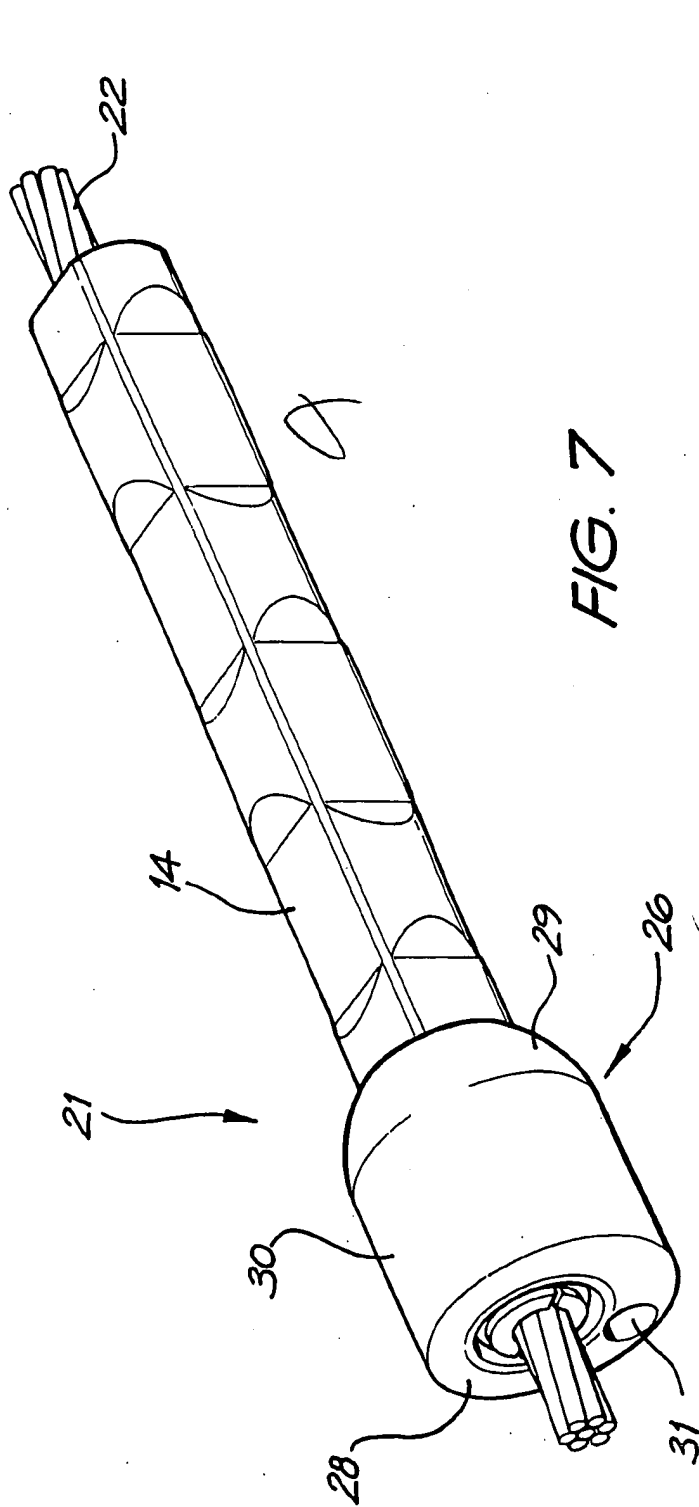
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2/6



3/6





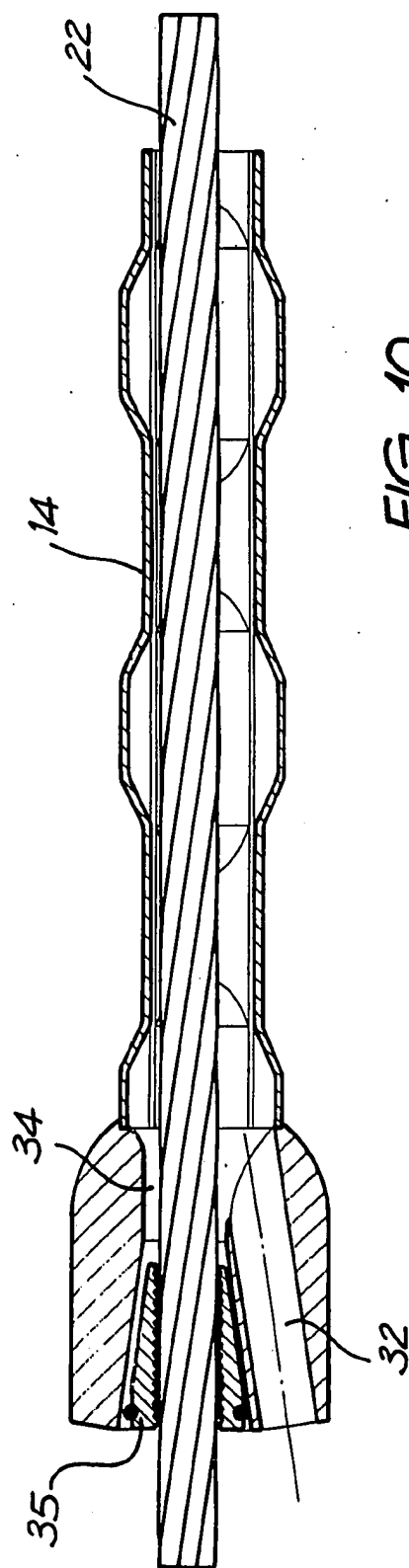


FIG. 10

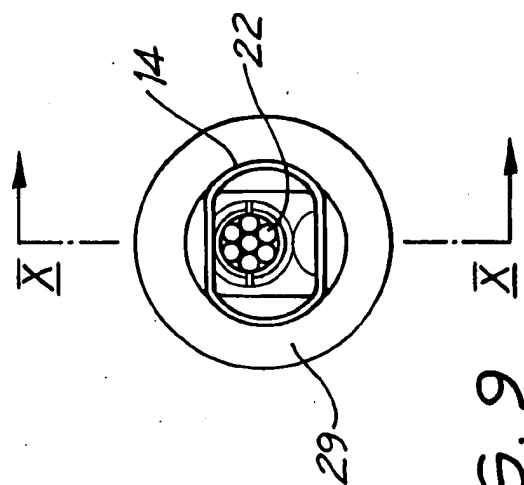


FIG. 9

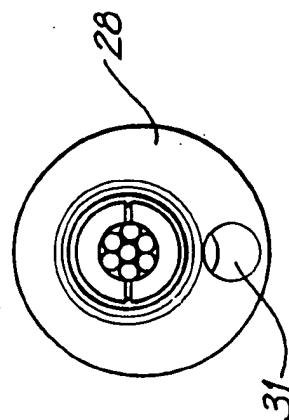
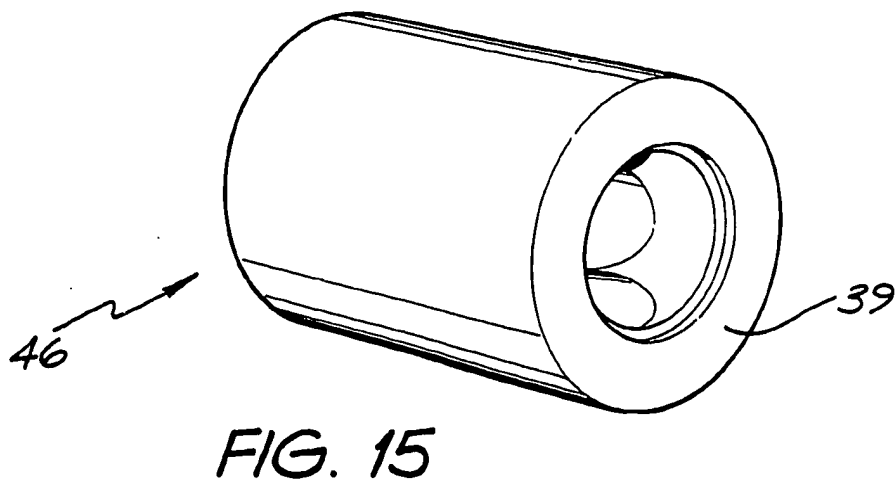
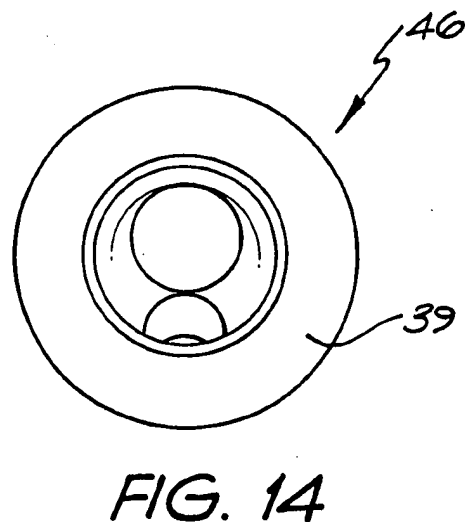
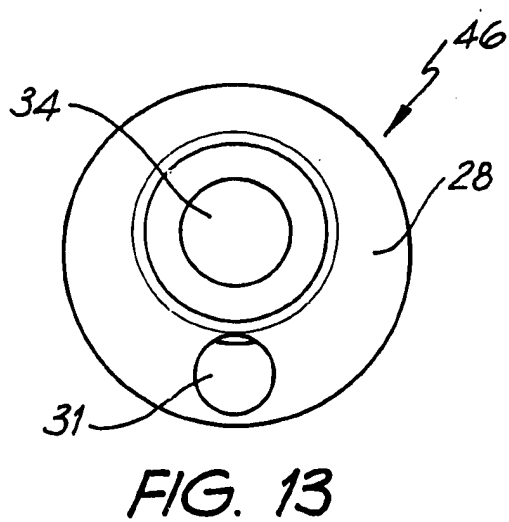
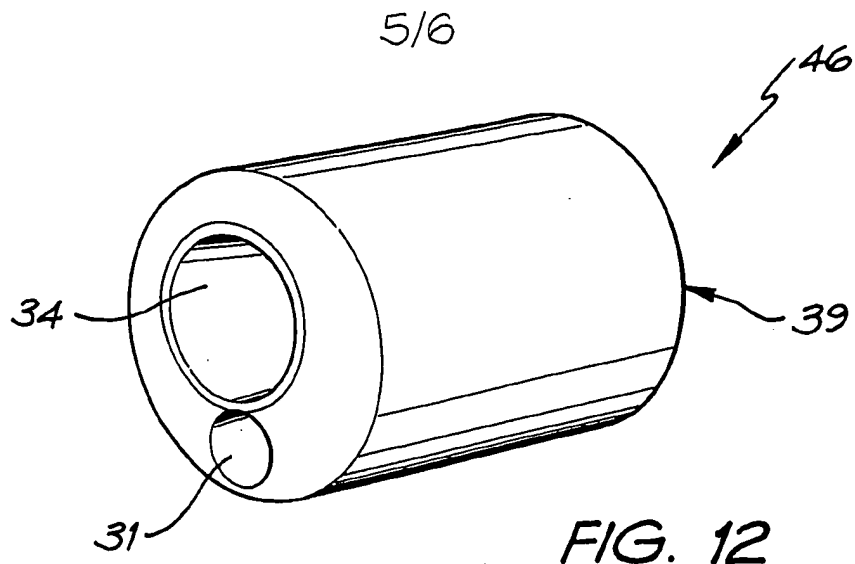


FIG. 11



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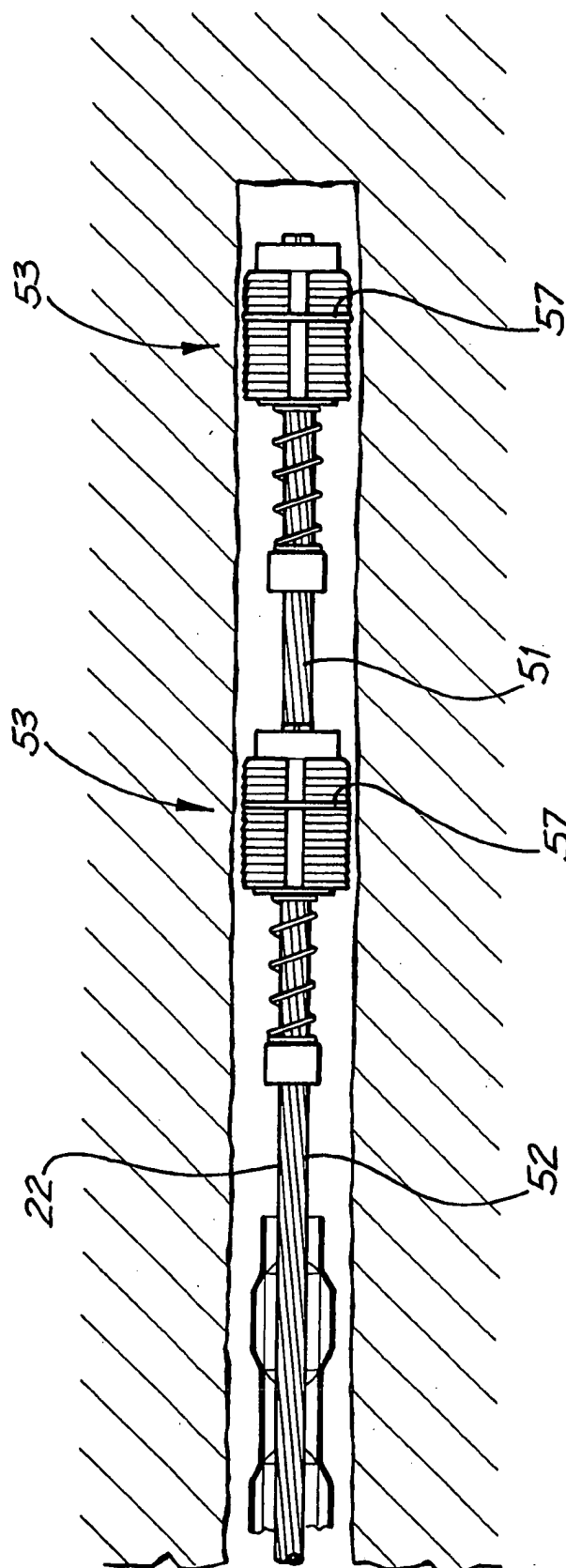


FIG. 16

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU03/00760

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
Int. Cl. <sup>7</sup> : E21D 20/02, 21/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC: E21D 20/02, 20/00, 21/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU: E21D 20/02 (1920 -1976)		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: sleeve+ and deform+		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 29712094 U1 (BERMULLER & CO. GmbH) 23 October 1997 See whole document	1
A	DE 4204533 A1 (GD ANKER GmbH) 19 August 1993 See whole document	1
A	EP 207030 B (ATLAS COPCO AB) 6 December 1989 See whole document	1
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
Date of the actual completion of the international search 2 September 2003		Date of mailing of the international search report 9 SEP 2003
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929		Authorized officer BARRY STEPHENS Telephone No : (02) 6283 2106

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU03/00760

C.(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5018919 (STEPHAN) 28 May 1991 See whole document	1
A	AU 200068072 A1 (SPRINGVALE COAL PTY LTD) 26 April 2001 See whole document	1
X	Derwent Accession No. 89-252469/35, Class Q49, SU 1460313 A (AS SIBE MINING INST) 23 February 1989	1, 19

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU03/00760

## Box I Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos :  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos :  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos :  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

## Box II Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

(see Supplemental Box)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-11, and 19-24

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU03/00760

### Supplemental Box

(To be used when the space in any of Boxes I to VIII is not sufficient)

#### Continuation of Box No: II

1. Claims 1-11 are directed to a tube for rock bolts comprising a tube extruded from plastics material deformed beyond its yield point at each of a plurality of longitudinally spaced apart locations extending along the length of the tube, said deformation at each location occurring in at least two different directions. It is considered that this arrangement comprises a first "special technical feature".

(Note: while the method of claims 19-24 for fabricating a tube for a rock bolt is not limited to tubes that are extruded from plastics material, the remaining features of the tube are identical to that of claims 1-11, and may therefore be searched therewith)

2. Claims 12-18 are directed to an end fitting for a rock bolt comprising a generally barrel-like shape having a front end, a rear wall, a curved side wall, a longitudinal axis, a (cable) tendon passageway extending between the front and rear ends, and a grouting orifice in said front end leading into said passageway. It is considered that this arrangement comprises a second "special technical feature".

3. Claims 25-26 directed to a rock bolt for use in poor ground conditions, including anchor means comprising at least two anchor devices connected in series on said bolt adjacent to its far end to anchor the far end adjacent the base of a blind hole formed in the ground, and tension means at the near end of the bolt to tension it after anchoring. It is considered that this arrangement comprises a third "special technical feature".

(Note: claims 27-28 directed to a method of securing a rock bolt in poor ground conditions is not limited to using a bolt having anchor devices connected in series: however they may be searched together with claims 25-26)

As these groups of claims do not share any of the identified "special technical features", a technical relationship as defined in Rule 13.2 of the PCT regulations does not exist.

Accordingly, the international application does not relate to a single invention, or to a single inventive concept

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU03/00760

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member				
DE	29712094	NONE					
DE	19971023	DE	4201533				
EP	207030	AT	48464	AU	58772/86	CA	1257976
		DE	3667318	EP	207030	FI	862545
		JP	62050600	NO	862361	SE	8502981
		ZA	8604497	CS	8609385	HU	57305
US	5018919	AT	98743	AU	53086/90	DE	4011900
		EP	394179				
AU	200068072	NONE					
SU	1460313	NONE					
END OF ANNEX							